

solid state

Vintage Dynaco SCA 80

By Bruce Brown

This Dynaco devotee shows you how to put a classic amp back into good use.

Most *audioXpress* readers are familiar with the products manufactured by Dynaco from the '50s to the early '70s. During this time Dynaco sold thousands of factory-built audio products and kits. These varied greatly, from tube amplifiers such as the Stereo 35 and 70, to integrated tube and transistor amps, to the monster ST 400 and 416. Dynaco offered real value and fun for the audio hobbyist.

There are probably several hundred modifications and updates for Dynaco equipment, with the largest majority for tube equipment. Online auctions for used Dynaco equipment often offer less popular items at a very reasonable price.

audioXpress has featured many articles on updating and rebuilding these older products. The very nice article written by Daniel Dufresne on the FM-5 and AF-6 tuners in the August 2003 issue inspired me to write this article on an often-overlooked integrated transistor amp, the SCA 80 (Photo 1). This amp combined the PAT 4 preamp (Dynaco's first transistor preamp) with the ST 80 transistor power amp.

the specifications of the SCA 80, you might be surprised to learn that it provides 40W RMS per channel into an 8Ω load with a total harmonic distortion of 0.5% from 20Hz to 20kHz.

It features much flexibility, with inputs for magnetic phono, tuner, tape, spare aux, and tape monitor. It also has a "special" input that you can configure for either a tape head input or a second phono input. In addition to the volume, balance, treble, and bass controls, it also features front panel tape monitor, loudness compensation, rumble filter, mode switch, and either a main/remote speaker connection or four-speaker "surround" system, depending on the model. I prefer the sound of the 80 se-

ries amps to the ST 120 amps. There were probably ten times as many ST 120s built as there were ST 80s, but even though the circuitry is similar, I think the 80 has far better bass response and is less "tiring" to listen to for long periods of time (my opinion, not based on any specs).

The preamp section of this amp uses two transistors in the low-level inputs and two others in the control circuit. These use a DC feedback loop to stabilize operating conditions, as well as an AC feedback loop to provide optimum audio performance. The tone controls provide a wide range of adjustment as well as a center "flat" setting. The amplifier section provides protection while delivering exceptional performance.

Transistors Q1 and Q2, which are a direct-coupled feedback pair, provide stability and linearity and drive Q3 through Q6. The amplifier circuit



PHOTO 1: Dynaco SCA 80 amp.

FEATURES

Audiophiles often ignore this unit, but it represents a compact, relatively powerful integrated amp—ideal for an office, bedroom, or dorm room. If you look at

is designed to reduce the current through the output if drive signals are excessive or under heavy loads. The output transistors are operated without quiescent current, which limits heat rise and eliminates the need for temperature compensation devices. The output capacitors, C7s, block DC from the speakers, yet allow unrestricted low-frequency response.

BACKGROUND

The first model (relatively rare) was the SCA 80, which had main and remote speaker outputs. The later, much more common, SCA80Q changed the speaker switching to include the DynaQuad circuit, and allow two rear speakers for an early "surround" sound. As an interesting sidelight, the Q model was rated at only 30W per channel, even though the circuitry was essentially identical. This was in spite of the Q model having heavier duty transistors for the driver and outputs.

I have repaired both and can tell you that either of these models actually will put out 35-40W RMS into an 8Ω

load. When restored, these amps will provide very pleasing sound and, combined with some vintage speakers, offer flexibility (not to mention the fun of resurrecting something that might have ended up in a landfill). With a little work and small investment, you will have an amp that will provide many more years of faithful service.

Safety note: You will be working on a live powered chassis with large storage capacitors. Use the same cautions you would working with high voltage circuits.

You will first need to locate an SCA 80 or SCA 80Q and the correct factory assembly manual. Many are listed in online auctions (often with one channel not functioning) and can be obtained inexpensively. As long as the power transformer is good, they are candidates for this restoration.

In addition to the two factory-assembled models, there are also kit versions. Usually factory-built units have a sticker on the back panel. This may

be missing due to the age of these amps, but you can usually tell by examining the wiring: kit-built units used mostly red wire for one channel and green for the other.

Factory-built ones used multicolored wiring that is identical for each module (*Photo 2*). You may also find that a previous owner "updated" the amp with various types of "audio-ophile" wire. It can be a rat's nest! I have found many times that modified amps are not wired correctly, or virtually all the soldered joints were suspect. If this is the case you should consider a complete rebuild of the chassis or find another one to modify. Make sure you ask questions if an auction listing does not specify conditions.

ASSESSMENT

Once you have your unit, you will need to pull the cover off and evaluate the operating condition. You should have a DVM (digital voltmeter), and, ideally, a signal tracer, as well as a set of inexpensive test speakers and a signal source such as a tuner or CD player. Check to see that the proper 2A slow-

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blow fuses have not been replaced with a larger one.

You will also need some contact cleaner. (I use a product named De-toxit 5.) Clean all the pots and switches thoroughly, then connect your speakers and audio source. If you have a Variac®, bring up the voltage to about 40V and then to 60. This will allow the power supply to charge and reform the capacitors.

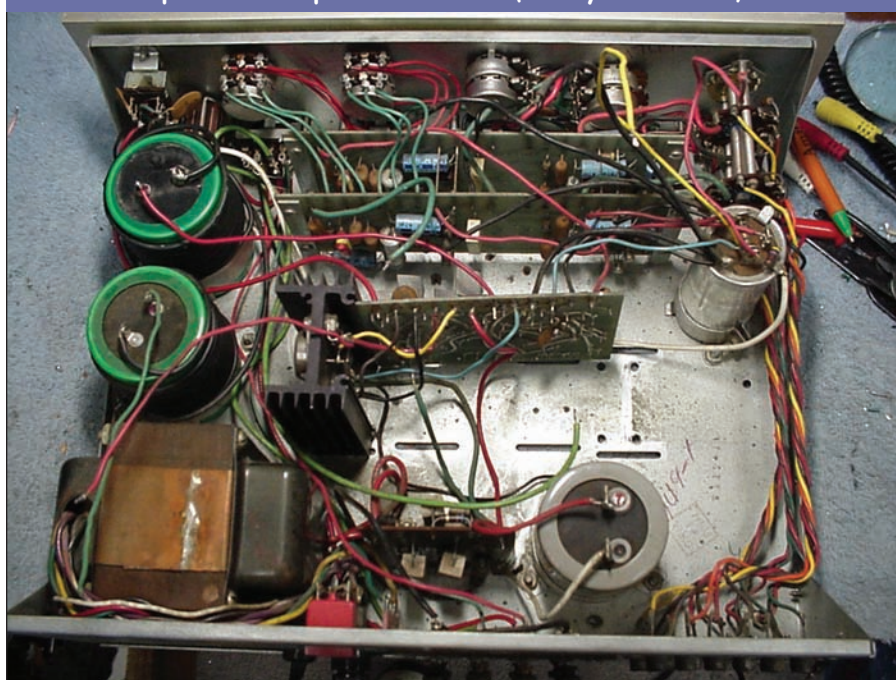
If you do not have a Variac, turn the power on, watch the components, and listen for bad sounds. If you experience excessive hum from either of the speakers, you probably have a shorted output transistor. Isolate the channel, power the amp down, and remove the power lead from the large single filter capacitor (doing this isolates the power transistors). This power lead comes from the top-most power transistor in each channel and connects to the positive lead of a large single filter capacitor.

Re-power the amp and continue with your testing. If you do not have smoke at this point, it is time to check some voltages. This may sound a little bit cavalier, but the protection circuitry built into this amp will generally prevent damage, and if the fuse holds, at least the power supply is functioning correctly. If you have a Variac, bring the AC up to 110V.

To evaluate the state of your amp, connect your DVM or voltmeter ground to the chassis and measure voltage with the positive lead, as follows:

1. Connect to the positive lead of the large filter capacitor C9 (the one sitting by itself). You should have approximately 70-75V DC. If so, the main power supply is functioning.
2. Connect to the positive post, one at a time, to each of the other large filter capacitors. You should have between 34-36V DC at each one. If you do not have these approximate voltages, you have a defective power amp channel. I will discuss this repair later. If you previously removed power from the power transistor, you will not have this voltage.
3. Next go to the smaller can capacitor. At the lead connected to the triangle marked section you should have around 70V DC. The one marked with the square should be around 24V and the one marked with the circle should be around 17.5V DC.
4. Now connect your positive lead to either of the power amp board's terminal 6, remembering the board has opposite orientation, and you should have about 37.5V DC at each of these points.

PHOTO 2: Amp with one amp module removed (factory-built version).



5. Next go to terminals 8, each of which should have about 36V. If either of these last two does not measure at 36, you have a bad transistor or a bad Zener diode on the power amp board. I will also discuss this fix later. (If you disconnect the power lead from one of the channels, only one of these two points will have the correct voltage.)

Proceed with audio sections testing. First set the input selector to the audio source you are using, then turn up the volume slightly and check the following:

1. Connect your signal tracer to ground and touch the probe alternately to each of the center terminals of the volume control. If you have signal here, the input switching system is working.
2. Now alternatively connect the probe to terminal 12 of each of the amp boards (PC-18). If you have good clean signal at this point, the preamp board (PC-17) is operating correctly. I have never had one of these amps with a preamp board failure, but if you have distortion at terminal 12 of either of the amp boards, you will probably need to troubleshoot the preamp (PC-17) and replace some small electrolyt-

ics or a preamp transistor. You may also choose to upgrade the capacitors on this board (see Update sidebar).

BOARD UPGRADE

The issue with most SCA 80s is the PC-18 amp board, and Dynaco made several versions. The early version used dark brown phenolic circuit boards with metal driver transistors that had "top hat" heatsinks (Q3 and Q4). The next version was a light tan board, again with metal driver transistors.

The final version of these boards was a translucent green fiberglass military-type board, which usually had plastic cased TO220 driver transistors with bolt-on heatsinks. This is the most stable version of this amp module, and I will update the older boards to the later version. If you have the later version, follow these troubleshooting details and replace defective and outdated components with the parts list.

You will need to remove each of the amp modules from the chassis for the following tests and modifications:

1. From PC-18, unsolder the wires that go to terminals 1, 6, 7, 9, 10, 11, and 12.
2. Remove the four bolts that hold the heatsinks in place from the bottom

of the chassis.

3. Unsolder the two remaining wire connections from terminals on PC-19 (the power supply board). There is also a ground wire that connects the lug on the base of C-19. The amp module is now free from the chassis. It is time to troubleshoot and update this module.

Driver transistors, especially Q3, are typically a problem on these boards. If any of your transistors is bad, you will also need to replace the Zener D1. I have included these in the parts list and I recommend that you replace them during the rebuild regardless. Early units used 2N3055 output transistors, while later ones used 2N3772s. The parts list calls for 2N3772s, which I recommend you use to replace all the outputs, regardless of the condition of the existing outputs in your amp.

Using your ohmmeter or a transistor tester, check each transistor while it is still in the circuit. If your amp was not working correctly, you will usually have one or two bad drivers and one or both outputs blown. You should also check the silicon diodes located at D2 and D3. In addition to the transistors, also replace some of the troublesome and outdated electrolytics on these boards.

Remove capacitors C3, C4, C5, and C6 from the boards, as well as the driver transistors Q3 and Q4, and the Zener diode D1. You also need to remove the 27pF ceramic capacitor C13, but save this for reuse on the back of the board. It is a good idea at this point to turn the board over and use a round toothpick and your iron to clean out the holes where all these components were mounted.

1. Replace C3 and C4 with new 33 μ F 50-100V non-polarized electrolytics.
2. Replace C5 with a new 470 μ F 16V electrolytic, making sure to observe correct polarity.
3. Where you remove C6, replace it with a 0.47 μ F 100V Mylar capacitor. On some boards this was a non-polarized cap, on some later ones, a Mylar was standard. There is no polarity on this one so install either

PHOTO 3: Soldering the pins on the board underside.



way.

4. Install the 68pF ceramic where C13, the 27pF, was located.
5. Install the new 5.1V Zener at D1 (be sure to observe polarity).
6. You will need to bend the leads of the TIP 31 and 32 to correctly align the pins for mounting in Q3 and Q4. Be sure to get the base, collector, and emitter leads in the correct holes. Q3 is the TIP 31C and Q4 is the TIP32C. You should also attach your new heatsinks to these transistors before you mount and solder them in place. Use a thermo pad on each of these, although it is not necessary to use insulating hardware.
7. Turn the board over and solder the 27pF ceramic between pins (*Photo 3*) to stabilize oscillation that may occur with some input sources.

Replace each of the output transistors mounted on the attached heatsink, using new thermo pads instead of the original mica insulators. Refer to the pictorial in the manual to get everything back in the right place. It is also

a good time to check the 0.47Ω 1W resistors on the back of the heatsinks. Many times these will be open or burned if the amp had a catastrophic failure.

TESTING

You now have one of the amp modules completed (*Photo 4*). Complete the same process with the other module. Then, carefully examine each module for solder bridges and make sure the new heatsinks do not contact any of the component leads.

Measure the resistance of each of the board-mounted resistors and replace any that are out of tolerance. Usually there are not many problems with these, but a little prevention here can save you time later. Before reinstalling the modules, it is a good idea to go through the amplifier and resolder all the attachment leads on the other circuit boards and controls.

Before connecting the leads to the large output capacitors, it is necessary to test these units. If either is faulty, the amp will not function correctly and your voltages may be considerably off.

I re-form both of these with a power supply capable of providing 75V. Connect the positive and negative leads of the power supply to the positive and negative terminals of the capacitor, slowly bring up the voltage over several minutes, and note the charging current. No current draw indicates an open cap; excessive current (greater than 25mA) indicates a shorted or leaky capacitor.

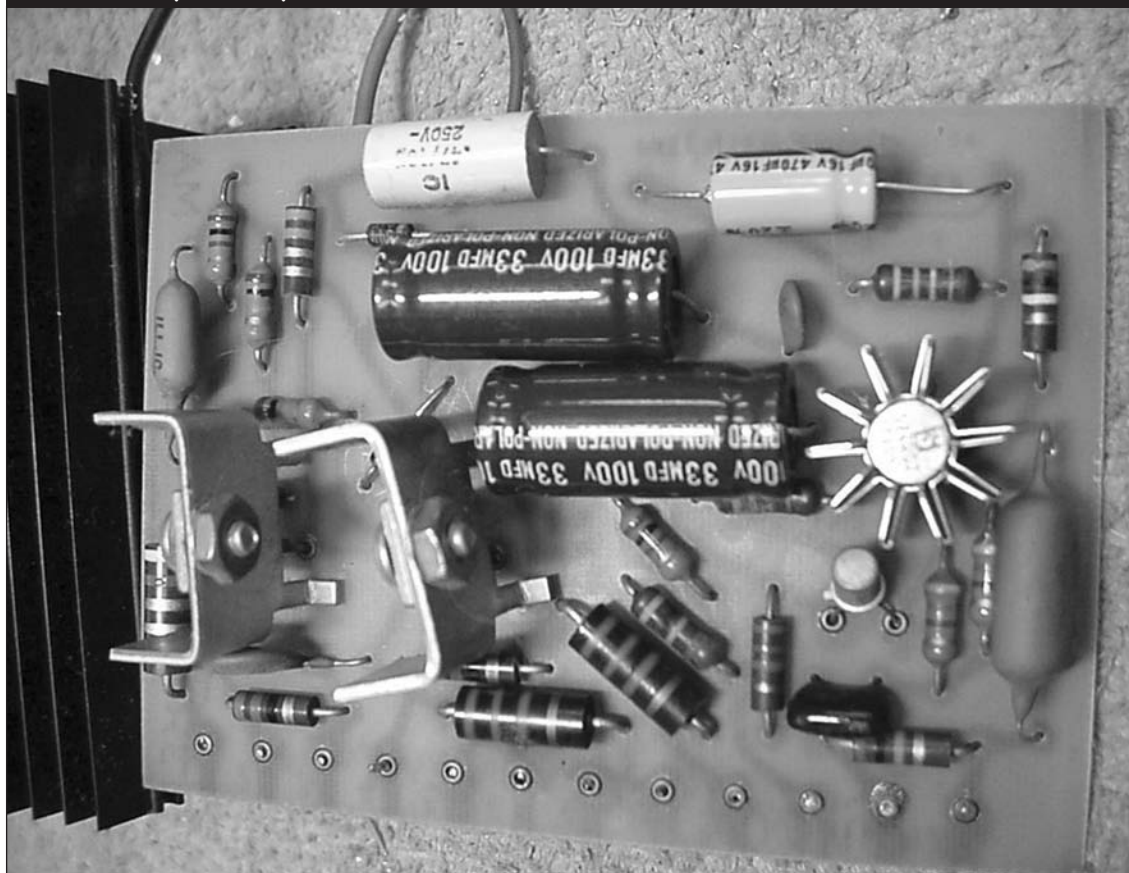
If you cannot keep the current below 25mA, you must replace the capacitor. An exact duplicate is very hard to find. Or, you can charge it with a 12V battery charger and then disconnect it and connect your DVM leads to the capacitor and monitor its slow discharge. If it takes a charge and slowly discharges, you can assume it will function correctly in the finished amp. If one of them is bad, you need a replacement.

New computer-grade caps of the same value will be smaller in diameter and will be difficult to transfer the large wire wrapped around it. This is an air core choke to stabilize the circuit and limit RF frequency flow to the outputs. You

can use the capacitor C9 from the power supply and transfer the wire to this, and replace C9 with a new 5000-6000μF 75-100V computer grade cap. You will also need the appropriate size clamp and drill new holes to mount it. Wire the new exactly like the original.

Remount and connect the leads to the modules and the power supply board. The most difficult part here is connecting the ground wire to the solder lug on the chassis attached to the power supply board. I usually

PHOTO 4: Completed amp module board.



solder these ground leads to the lug before I re-mount the modules on the chassis.

After you have completed all the wiring, check everything very carefully, using *Fig. 1*. A misconnected module can very easily destroy several of the semiconductors and require starting all over.

Reconnect your speakers and audio source and fire it up. A Variac is handy, but not necessary. You should be rewarded with very clean sound. It is also a good time to check the function of all the controls and switches. You may find the controls need a second shot of contact cleaner to ensure quiet operation.

This amplifier will drive most reasonably efficient speaker systems. I like the sound of Dynaco A-25s or vintage Advents. (These are also reasonably available and affordable in on-line auctions.) Consider purchasing a Dynaco FM-5 or AF-6 to match your newly refurbished amplifier. I recommend you perform the modifications covered in the 2003 article to complete your vintage system. In a sidebar (Dynaco FM5 Dial Light), I have included a further update for these tuners that makes their maintenance easier.

I hope you enjoyed this rebuild. I will be happy to try to assist you with any questions you might have. You can contact me at my e-mail address: Tuninfork@aol.com.

DYNACO PREAMP BOARD UPDATE

Frank Van Alstine, of Audio by Van Alstine, was a leader for many years in the modification of Dynaco equipment. In the November 1986 (Volume 5, Number 11) issue of *Audio Basics*, he published an article about updating the PAT-4 preamp. You can go to his website (www.AVAHIFI.com) and search the back issues of *Audio Basics* to print out a copy of this article. Since the PAT 4 and the SCA 80 preamp boards are the same, you can use his recommendations to replace the outdated components, notably the small electrolytic capacitors in the preamp circuit, with tantalum caps.

He replaces some of the larger electrolytics with large film caps. The cost for the capacitors for this rebuild is about \$50. If you perform this modi-

PARTS LIST

Amp module rebuild (both modules)

4- 2N3772 power transistors (Electronic Goldmine, www.goldmine-elec.com)

4- TO3 thermo pads (packs of 5 available from Mouser Electronics, www.Mouser.com, 526-NTETP0001)

2- TIP31C plastic TO220 transistors (Electronic Goldmine)

2- TPI32C plastic TO220 transistors (Electronic Goldmine)

2- 5.1V Zener diodes (Mouser 78-IN5231B)

4- 33µF 30-100V non-polarized electrolytic capacitors (Mouser 140-NPRL 50V33)

2- 470µF 16V electrolytics (Mouser 647-TVX1C471MAA)

2- 0.47µF 100V capacitors (Mouser 75-225P100V0.47)

2- 68pF 100V ceramic capacitor (Mouser 581-SR151A680J)

2- 0.47µ 2W resistors (Mouser 283-0.47) see text

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fication plus my modifications, you will have eliminated most potential problems with this vintage amp. This will much improve the sound of the preamp section of the PAT-4 and also the SCA 80.

Do not try to use his recommendations for power supply changes because they apply specifically to the PAT-4. He also describes how to rewire the input selector of the PAT-4 for an additional Aux input; this is also not applicable to the SCA 80 or Q.

DYNACO FM 5 DIAL LIGHT

As many folks have discovered, the dial lights in the FM-5 and AF-6 are not readily available. The original factory lamps are significantly longer than currently available "fuse" type lamps. McIntosh does sell long lamps that will work, used in the early MX tuners, charging \$10 each.

A far less expensive solution is to use short "fuse" lamps with an adapter to lengthen them. My friend Larry uses two *fired* .22 caliber rifle shells, one slipped on each end of the lamp. If you use these cases, be sure to use *only*

fired cases, not ones with the bullet pulled and powder removed. Unfired cases will still have an active primer, which can be set off by the electric current of the lamp heat.

I prefer to replace the original holders with standard fuse holders and then use currently available "fuse" lamps. The parts you will need are listed at the end of this sidebar.

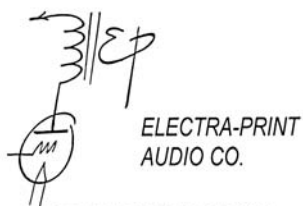
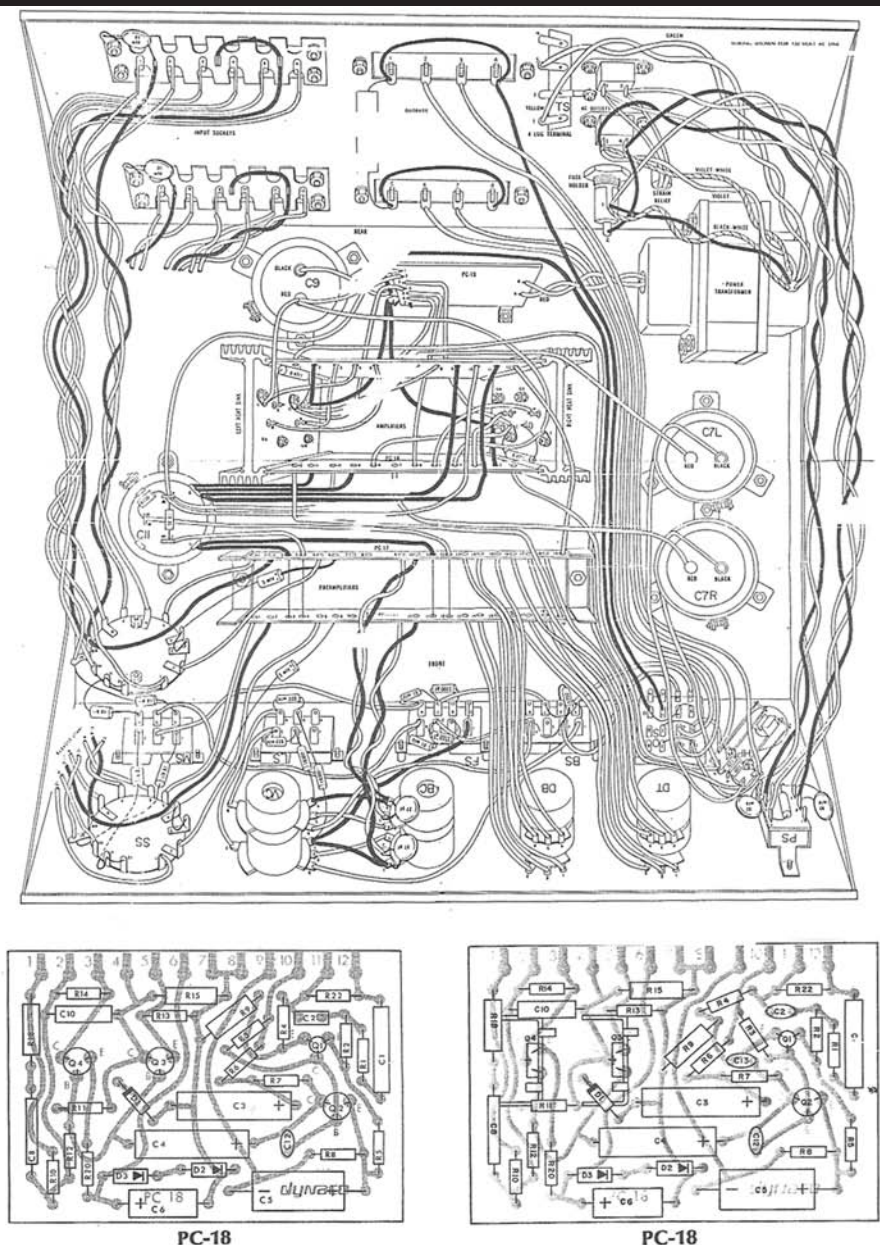
Another common issue is failure of the "tuned" lamp or "stereo" indicator lamp. Gregg Dunn's Dynaco site contains information on replacing these two grain-of-wheat lamps with LEDs. The tuner will not work properly with-

out them in place, so if your unit does not kick into stereo, replacing this lamp will generally fix it. I repeat those instructions.

For these procedures you will need the following:

- 2- 8V fuse lamps (All Electronics LPFS-8)
 - 2- fuse holders (All Electronics FHBL-3)
 - 2- Blue LEDs (All Electronics LED-94) (You can use white ones also)
 - 2- 15K ½W resistors (All Electronics) see text
 - 12" of ⅜" heat-shrink tubing.
- First remove the case cover, knobs,

FIGURE 1: SCA 80 diagram.



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and faceplate. Carefully remove the existing fuse lamps and holders. Using the same mounting hardware, install the new fuse holder. The ground lugs may need to have a longer piece of wire attached to them to work with the new holders. Once you have mounted them, install the new 8V lamps.

Now carefully remove the "tuned" lamp from its bezel. Cut the leads close to the bulb and attach the blue wire to the longest lead of the LED. Cut a piece of heat shrink and place on the wire lead before you solder the connection. Completely cover the exposed wire and LED lead with the heat shrink. Place a longer piece of heat shrink on the other lead.

Connect the resistor to this lead and the other end to the short lead of the LED. Completely cover the resistor and exposed LED lead with the heat shrink. Push the LED into the bezel. Follow the same procedure with the "stereo" light.

Now plug in and turn on the tuner and make sure that the LEDs function and the stereo light comes on when you tune in a stereo station (you should have the mode switch in the stereo position). If neither of these LEDs lights, or you do not have any blue leads on the grain-of-wheat lamps, you may need to reverse the leads. If neither works in either position, you have another problem with the tuner and it will require troubleshooting.

If both LEDs are on all the time, but become brighter when the tuner is tuned, you must increase the value of the resistors. This depends on the current draw of various LEDs. (I have used values as low as 10k and as high as 20k for them to light correctly.) Now clean the dial glass and reassemble the face and case. These simple modifications will make it easier to replace the dial lamps in the future, and virtually eliminates replacement of the tuning and stereo lights. *aX*

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Acknowledgment

I want to thank my wife Kristin for her understanding and wordsmithery of my articles. Without her help, you would not be able to decipher my ramblings.



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